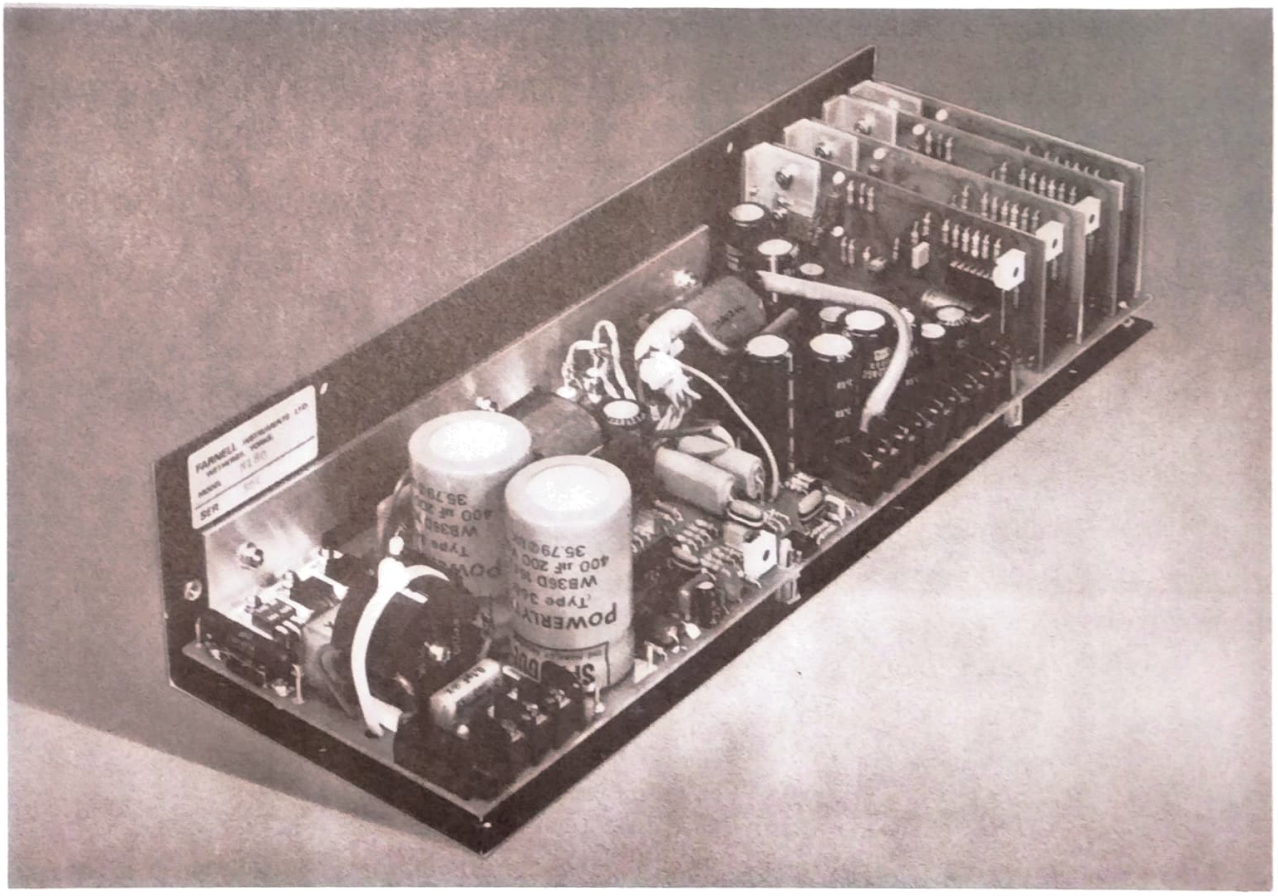
Provisional data

# Farnell

## multi-output power supplies–MOPS



**● Switched-mode technique for compactness and high efficiency ● Open frame construction (optional cover) ● Standard models have five outputs: ±5V; ±12V and +24V d.c. ● Alternative outputs to order ● 160 and 180 watt units (other versions soon) ● Foldback current limit protection on all outputs ● Soft start limits in-rush current ● 18mS minimum hold-up time ● Convection cooled ● Simplified mounting in any plane ● R.F.I. suppression to BS800 and VDE 0875 curve N ● Design and construction in accordance with UL478 and BPO Technical Guides 2 and 26 (sections 1.3, 1.3.1 and 2.5.1 respectively) ● British design and manufacture ● Tailored versions and custom designs to order**

*Applications:*

**● Computers ● Logic systems ● Mini and micro computers ● Computer peripherals: terminals, floppy disc drives etc. ● Microprocessor systems ● Business machines**

Farnell introduce MOPS (multi-output power supplies) in economy open frame packages for OEM use in microprocessor systems, computers and peripherals, and business machines.

Using switched-mode rather than linear techniques, MOPS are small, easily mounted and highly efficient. They run cooler than linear units and do not require fans. An optional cover is available.

160 watts (regulated) and 180 watts (semi-regulated) standard units with five outputs are currently in production and other models are in the late design stage. The standard outputs are +5V; ±12V and +24V d.c. but alternatives can be had to order.

Soft start circuitry limits in-rush current and at least 18 mS hold-up time is provided. R.F.I. suppression is to BS800 and VDE 0875 curve N. Designed and constructed in accordance with UL478 and BPO standards, MOPS are of British design and manufacture but will second source some North American and European models.

Farnell have nearly 25 years expertise in power supplies and almost a decade's experience in volume production of switched-mode units. With two superb production plants located at Wetherby (67,000 ft²) and Boroughbridge (23,000 ft²) plus its own transformer manufacturing unit at Bishop Auckland, Farnell are capable of high volume, contract work to DEF 0524 standards and regularly supply off-the-shelf models, tailored versions and custom designs to many internationally known companies. There are sales/service departments in Wetherby and Harpenden, subsidiary companies in France and Italy and a European distribution network exists to fully support the multi-national OEM production line.

## Specification

**Mains input** 220 to 240V or 115 to 120V set by link on circuit board. 45 to 440Hz

**Mains variation tolerated** 220 - 20% to 240 + 10% (176 to 264V) or 115 - 20% to 120 + 10% (92 to 132V)

**Outputs**

| | V nom. | I max. | N160R* | N180* |
|---|---|---|---|---|
| Output 1 | +5V | 20A | Regulated | Regulated |
| Output 2 | +12V | 5A | Regulated | Semi-regulated |
| Output 3 | -12V | 5A | Regulated | Semi-regulated |
| Output 4 | +24V | 2A | Regulated | Semi-regulated |
| Output 5 | -5V | 1A | Regulated | Semi-regulated |

* 160 watts total max. power
* 180 watts total max. power

**Voltage adjustment** Output 1: 4.75V to 5.25V
Outputs 2-5: +5% approx. (N160R)
Note: Model N160R has adjustment pots. on all outputs. Only output 1 can be adjusted on N180 and outputs 2-5 will vary in proportion

**Ripple and noise**

| | |
|---|---|
| N160R model | Less than 50mV pk-pk all outputs ($\Delta f$ = 30MHz) |
| N180 model | 2% max. pk-pk<br>40mV max. r.m.s. |

**Temperature coefficient**

| | |
|---|---|
| N160R model | +0.02% per °C typical, all outputs |
| N180 model | Output 1: +0.02% per °C typical<br>Outputs 2-5: +0.05% per °C typical |

**Operating ambient temperature range** 0°C to +50°C for full output current rating. Convection cooled. No additional heatsink needed

**Maximum operating ambient temperature** All outputs and total maximum power output derate linearly from I max. and Po max. to half I max. and half Po max. respectively at 70°C

**Output voltage regulation**

| | |
|---|---|
| N160R model | ±1% max. deviation (including sum effect of line, load and cross regulation) |
| N180 model | |
| *Line regulation* | All outputs: 0.2% max. deviation for mains variation of 198 to 264V or 103 to 132V |
| *Load regulation* | Output 1: ±1% max. deviation<br>Output 2: ±3% max. deviation<br>Output 3: ±2% max. deviation<br>Output 4: ±2% max. deviation<br>Output 5: ±2.5% max. deviation<br>(for ±40% load change from 60% I max. on considered output only) |
| *Cross regulation* (measured output set at 20% max. rated load) | Output 1: ±0.5% max. deviation (for ±25% change from 75% I max. on any output)<br>Outputs 2-5: ±1.5% max. deviation (for ±25% change from 75% I max. on output 1)<br>±0.5% max. deviation (for ±25% change from 75% I max. on any output except 1) |

**Switch on surge** Soft start limited to 16A max. peak current

**Insulation** Unit isolation barriers (input to output) including layout and wiring are designed to meet a test of: 4kV r.m.s. for 1 minute input to output (i.e. 2kV r.m.s. input to earth, 2kV r.m.s. output to earth)
Appropriate tests applied to all relevant components to ensure compliance with BS3535 clause 17B and CEE15 clause 17c.
The complete unit is tested at 2.1kV d.c. for 1 minute between a.c. input and d.c. output with output terminals and earth connected together. Tested to 500V d.c. for 1 minute, output to earth

**Storage temperature range** -25°C to +85°C

**Hold-up time** 18mS minimum. Output will be maintained for the duration of a missing half mains cycle at maximum output power and 220V -10% or 115V -10% mains input

**Safety specifications** Designed and manufactured in accordance with UL478 and BPO Technical Guides 2 and 26 (sections 1.3, 1.3.1 and 2.5.1 respectively)

**Protection**
*Overload:* Self resetting foldback current limiting on all outputs (N160R) and on output 1 only on N180 model. Overall power output limited to approx. 120% of full rated output
*Overvoltage:* Available as standard on all 5 outputs (N160R)
5V outputs - operates at 5.8 V min. 7V max.
12V outputs - operates at 13V min. 16V max.
24V output - operates at 26V min. 30V max.
Model N180 has overvoltage protection on output 1 only

**Radio frequency interference** Units comply with the conducted interference requirements of VDE 0875 curve N and BS800

**Efficiency** N180 80% typical, N160R 70% typical

**Dimensions/weight**

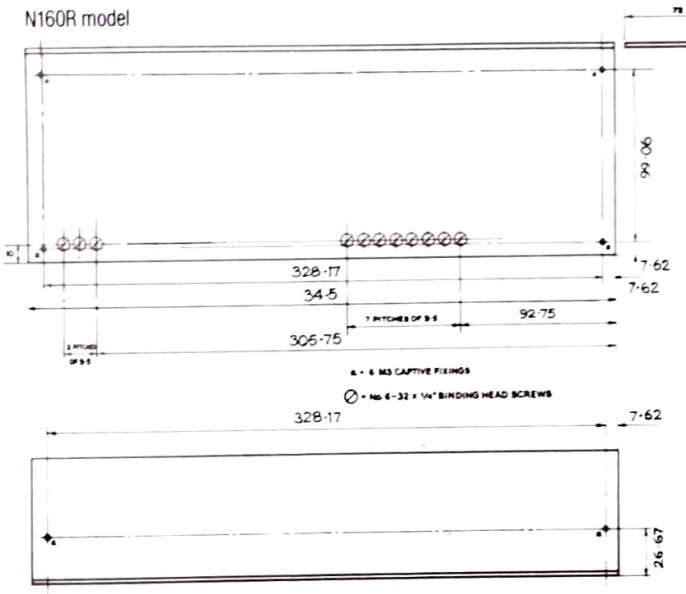
| | N160R | N180 | |
|---|---|---|---|
| Height | 72mm | 72mm | |
| Width | 121.6mm | 121.6mm | ±0.5mm |
| Depth | 345mm | 266.5mm | |
| Weight | 2.0 kg | 1.4 kg | |

**Cover** Optionally available

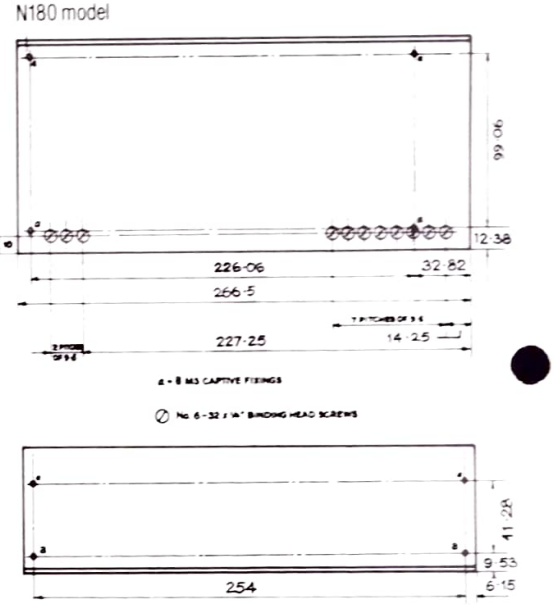
**Connections** Slotted screw terminals on barrier strips. 3 way barrier strip for supply input. Separate barrier strip for outputs

**Mechanical details**

N160R model




N180 model

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*We reserve the right to amend specifications without notification.*

OPERATING INSTRUCTIONS FOR

Farnell

# MOPS-OPEN FRAME MULTI-OUTPUT POWER SUPPLIES N300R & N350

## INTRODUCTION

The Farnell MOPS range of multiple output switching power supplies provide the microprocessor user with an economic and efficient power source for his whole equipment. A single unit can provide five d.c. output voltages which are suitable for powering peripheral display, storage and input devices as well as the processor and memory.

This instruction sheet describes units based on the N350 and N300R systems which can deliver 350 watts and 300 watts total output power respectively. The N300R has all outputs fully regulated and the N350 has one fully regulated output with the remainder semi-regulated.

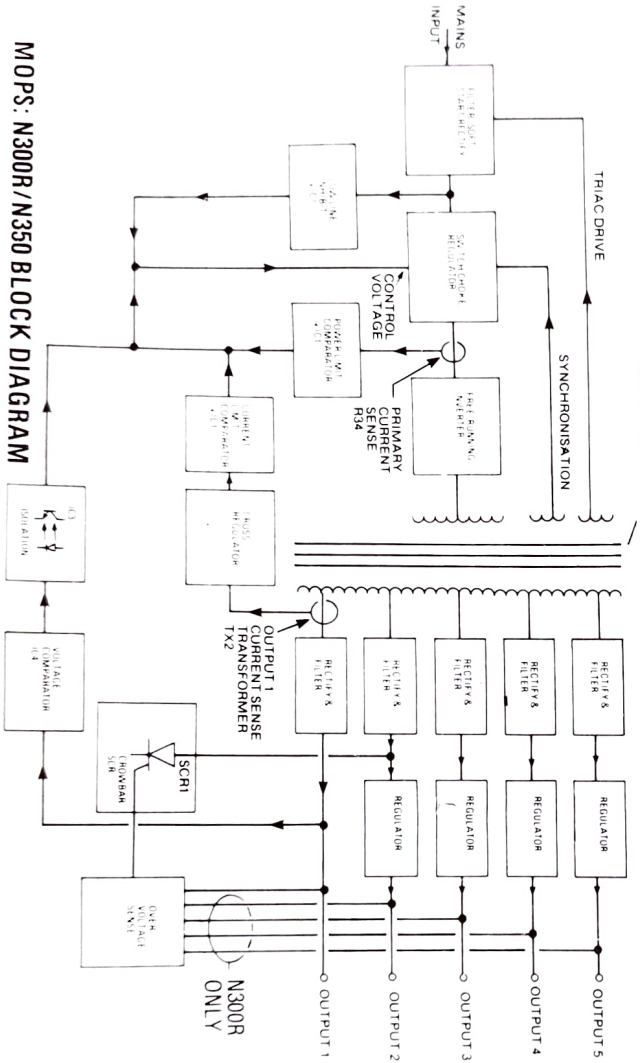
The standard outputs are +5V, +12V, -12V, +24V and -5V but many other combinations of voltage can be manufactured to special order. These units are of open frame construction for incorporation inside other equipment and an optional cover is available.

The units may be operated from a.c. supply voltages of 115V and 230V nominal and are designed to meet several international specifications - UL478, BS800, VDE0875, CEE15.

Two versions of both the N350 and the N300R are available: one designed for cooling by natural convection and the other designed for forced air cooling. A detailed discussion of reliability and temperature rise is contained in the application note: Temperature and reliability'.

## SCHEMATIC DIAGRAM

INVERTER TRANSFORMER TX5 REGULATORS FITTED ON 300R ONLY




## MOPS: N300R/N350 BLOCK DIAGRAM

## SPECIFICATION

VARIATIONS FROM THIS SPECIFICATION FOR NON STANDARD UNITS ARE INDICATED ON THE REVERSE OF THIS SHEET. ALL VALUES SPECIFIED FOR AN AMBIENT TEMPERATURE OF 25°C UNLESS OTHERWISE INDICATED.

**Mains input** 176 to 264V a.c. r.m.s.: 230V tap. 92-132V a.c. r.m.s.: 115V tap. Selected by link on circuit board. Frequency 45 to 440Hz. 250 to 370V d.c. on 230V tap only.

**Input current** (at full load, typical)

| | 115V | 220V | 240V |
|---|---|---|---|
| RMS | 5.4V | 3.0A | 2.8A |
| MEAN | 2.5A | 1.3A | 1.2A |
| REPETITIVE PEAK | 16A | 9.5A | 9.5A |

**Switch on surge.** 30A max. peak current. 16A typical

**Standard outputs** (N350/F4124 and N300R/F4113 only) If unit is non-standard refer to reverse of this sheet for output voltages and currents.

| | Voltage (nominal) | Current (maximum |
|---|---|---|
| Output 1 | +5V | 40A |
| Output 2 | +12V | 5A |
| Output 3 | -12V | 5A |
| Output 4 | +24V | 5A |
| Output 5 | -5V | 1A |

**Maximum output power. N350** unit - 350 watts total. **N300R** unit - 300 watts total. Note: it is necessary to derate the maximum current taken from one or more of the outputs to restrict the output power to the above figures.

**Output voltage adjustment. N300R** - each output individually adjustable by ±5% from nominal. Factory preset to within 0.5% of specified nominal. **N350** - output 1 adjustable ±5%. Other outputs vary in proportion as output 1 adjusted. With output 1 set to 5.00V and all outputs loaded at 50% of maximum rated current the other outputs will be within 5% of the stated nominal voltage.

**Output voltage regulation. N300R** - each output 1% maximum total change in voltage for a zero to full load change on the measured output, the worst case change of loads on the other outputs, and a line change of 176 to 264V or 92 to 132V. Note: full output current can be obtained from outputs 2 to 5 with a minimum 20% load on output 1.

**N350**

LINE REGULATION: Each output 0.2% maximum change for a line change of 176 to 264V or 92 to 132V.

LOAD REGULATION:

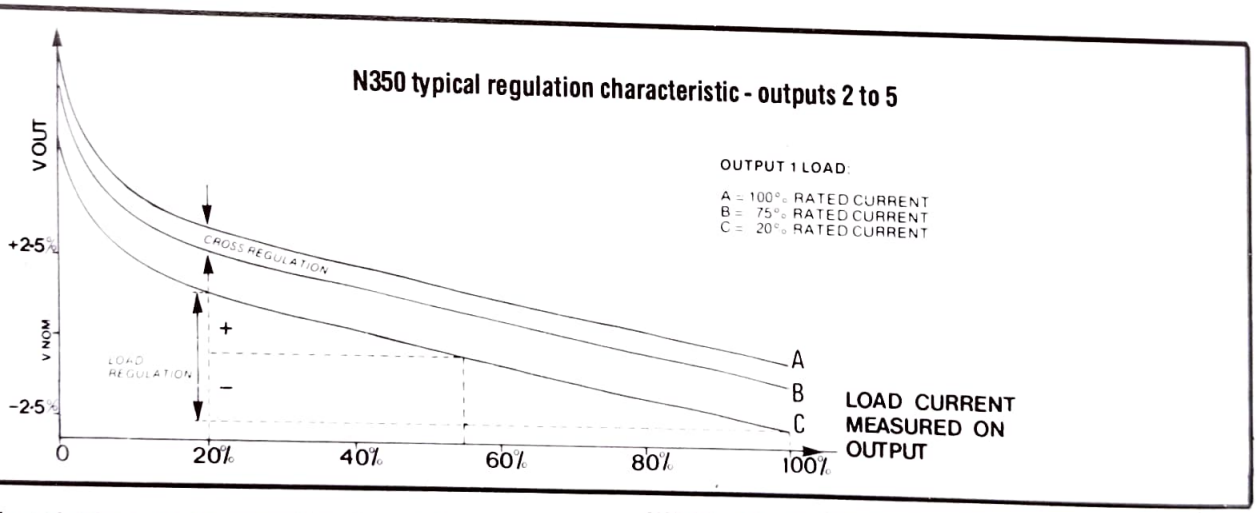
| | |
|---|---|
| Output 1 | ±1% max. change |
| Output 2 | ±3% max. change |
| Outputs 3 to 5 | ±2.5% max. change |

For a 40% load change from 60% Imax (i.e. from 60% to 20% or 100% max. rated load) on the measured output All other outputs at 20% max. rated load.

CROSS REGULATION. All outputs ±0.5% max. change for a ±25% load change from 75% Imax on any one of outputs 2 to 5. Other outputs set at 20% max. rated load.

Outputs 2 to 5: ±1.5% max. change for a ±25% load change from 75% Imax. on output 1. Other outputs set at 20% max. rated load.

**N350 typical regulation characteristic - outputs 2 to 5**




**Ripple and noise** (outputs proportionally loaded, total giving max. rated output power) $\Delta f = 30MHz$
**N300R** - not greater than 75mV pk-pk: 20mV r.m.s.
**N350** - not greater than 2% Vout pk-pk: 0.5% Vout r.m.s.

**Temperature coefficient** (typical) **N300R** - All outputs ±0.02% per °C.
**N350** - Output 1: ±0.02% per °C. Outputs 2 to 5: ±0.05% per °C.

**Output hold-up time.** All outputs will be maintained for the duration of a missing mains half cycle (18ms from last mains peak) at nominal output voltage, maximum output power and 220V-10% or 115V-10% mains input. At higher input voltages and lower output power the hold-up time is increased as shown in the graph below.

**Protection.** OVERLOAD: Self resetting foldback current limit set to approximately 115% of rated output current.

**N300R** - all outputs protected **N350** - current limit on output 1 only. Overall power limit at approximately 120% of rated power. Outputs 2 to 5 fuse protected
OVERVOLTAGE: **N300R** - protection provided on each output **N350** - protection provided on output 1
5V outputs - operates at 5.8V min, 7V max.
12V outputs - operates at 13V min, 16V max.
24V outputs - operates at 26V min, 30V max.
An overvoltage shuts down all outputs. Reset by interrupting the mains supply. FUSE: The mains input is fused (fuse type 20mm 10A T HRC).

**Remote sensing.** Output 1 terminal voltage must not exceed 5.25V.

**N350** - Note that outputs 2 to 5 will vary with variation in lead drop. **N300R** - Outputs 2 to 5 load currents should be derated by 5% when operated with a main terminal voltage of 5.25V.

**Efficiency** (at max. output power) **N350** - 80% typical. **N300R** 65% typical.

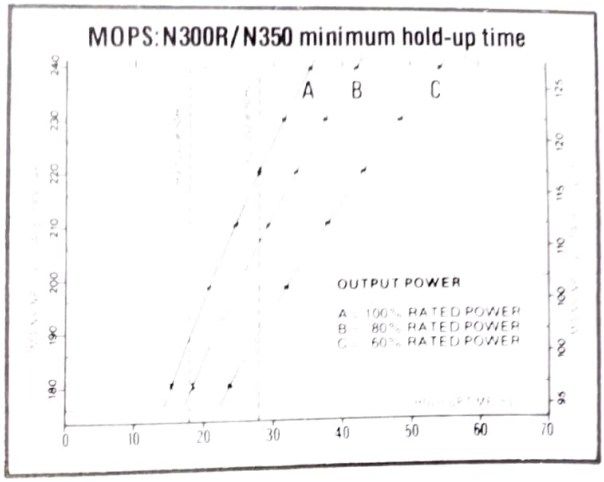
**Operating ambient temperature range** 0°C to 70°C. Derate linearly each output current and the total output power from max. at 50°C to half these values at 70°C.

**Storage temperature range** - 25°C to 85°C.

**Radio frequency interference.** The units comply with the conducted interference requirements of VDE0875 curve N and BS800.

**Insulation** Unit input to output isolation barriers, including layout and wiring, are designed to meet a test of 4kV a.c. r.m.s. for one minute (i.e. 2kV r.m.s. input to earth, 2kV r.m.s. output to earth). Tests are applied to relevant components to ensure compliance with BS3535 clause 17b and CEE15 clause 17c. The complete unit is tested at 2.1kV d.c. for 1 minute between a.c. input and d.c. outputs, with output terminals connected to earth. Tested at 500V d.c. for one minute between output and earth.

**Safety specifications** Designed and manufactued in accordance with UL478 and BPO Technical Guides 2 and 26 (sections 1.3, 1.3.1. and 2.5.1 respectively).



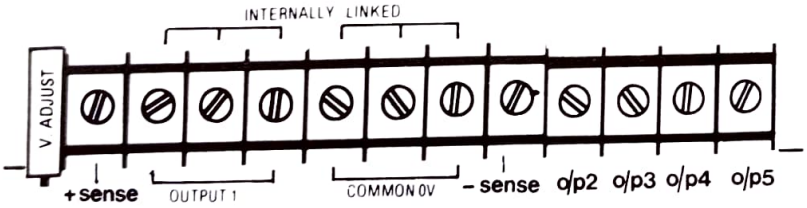

**Cover.** Optional. Available to order.

**Connections.** Slotted screw terminals on barrier strip. Three way barrier strip for supply input. Separate barrier strip for outputs (see drawing).

## OPERATING INSTRUCTIONS

**Warning: Hazardous voltages exist at many points within the unit.** It is intended that this power supply be built into the user's equipment and that he provides protection against accidental contact. Where this cannot be done a cover should be fitted, which is available to order from Farnell Instruments Ltd. DISCONNECT THE MAINS INPUT SUPPLY BEFORE TOUCHING THE UNIT. If the unit requires servicing it is recommended that it be returned to the manufacturer.

**Mains input.** The mains input terminals are on the 3 way block at the edge of the circuit board and are marked L (live), N (neutral) and E (earth). The unit as supplied will operate from a 220 to 240V a.c. supply. For operation from 115 to 120V a.c. supplies a link should be fitted between the circuit board pins marked appropriately,

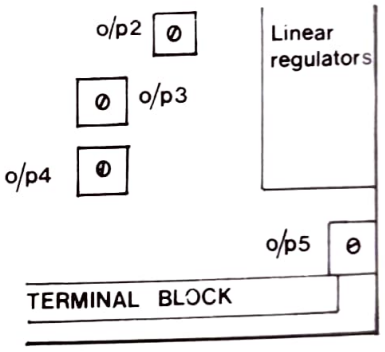



adjacent to the mains input terminals. NOTE: the link should only be fitted for low input voltage operation.

**Output connections.** The output connections are on the 12-way terminal block, arranged as shown above.
The Common and Output 1 terminals are duplicated so that the current may be shared between them. The output voltages and maximum currents are indicated in the specification (reverse of sheet for non-standard units) but it is necessary to derate the maximum current taken from one or more of the outputs to restrict the total load to the power rating of the unit. The **N350** unit requires a minimum load on each output of 20% Imax for the output voltages to remain within specification. The **N300R** requires a minimum load on output 1 of 20% Imax for the auxiliary output voltages to remain within specification. Both units may be operated at lighter loads than this.

NOTE If remote sensing is required, connect the + sense and - sense to **OUTPUT 1** load terminals. If not, the + sense and - sense must be connected to **OUTPUT 1** and common 0V respectively on the unit terminal block.

**Output voltage adjustment.** Output 1 may be varied ±5% from nominal by adjustment of the multiturn potentiometer indicated on the diagram. On the **N350** this will cause a proportional change in voltage on the other outputs.
On the **N300R** all the outputs are fully regulated and outputs 2 to 5 may be individually varied ±5% from nominal by adjustment of the potentiometers on the circuit board indicated below.
NOTE: Output voltages and regulation should be measured directly at the terminal block for the purpose of the specification.




**Mounting and ventilation.** The power supplies are provided with M3 threaded fixing holes in both faces of the 'L' shaped chassis. Fixing screws should not penetrate more than 5mm. For the natural convection cooled unit provision should be made to allow for free air flow round the unit. For the forced air cooled unit a typical air flow of 1 cubic metre per second should be provided - see application note 'Temperature and reliability' available from Farnell Instruments Limited.

## GUARANTEE & SERVICE

This power supply is guaranteed against defective components or faulty manufacture for a period of 12 months from the date of despatch from Farnell Instruments Ltd or an approved Agent.
We recommend that should it need repair it is returned to The Service Dept. of Farnell Instruments Ltd or an approved Agent.

## CIRCUIT DESCRIPTION

The following is a simplified description of the N350 and N300R units and should be read with reference to the schematic diagram provided above.

The filtered mains input is connected to a switch choke regulator which reduces the rectified input voltage to approximately 150V. This 150V rail powers a self-oscillating inverter which drives a transformer at about 22kHz. Secondary windings on this transformer provide different voltages for the various outputs which are individually rectified and filtered. Feedback is taken from output 1, via an opto-isolator, to control the duty ratio of the switch choke regulator transistor and stabilise output 1 by controlling the nominal 150V rail.

Extra windings on the inverter transformer synchronise the operation of the switch-choke regulator with the free-running inverter and provide drive to the triac which bypasses the input soft-start resistor.

Output 1 load current, via a current transformer, is sensed by a comparator and in the event of an overload the current is restricted by controlling the switch choke regulator to reduce the 150V rail.

Similarly an overall power limit is provided by restricting the current drawn from the switch choke regulator.

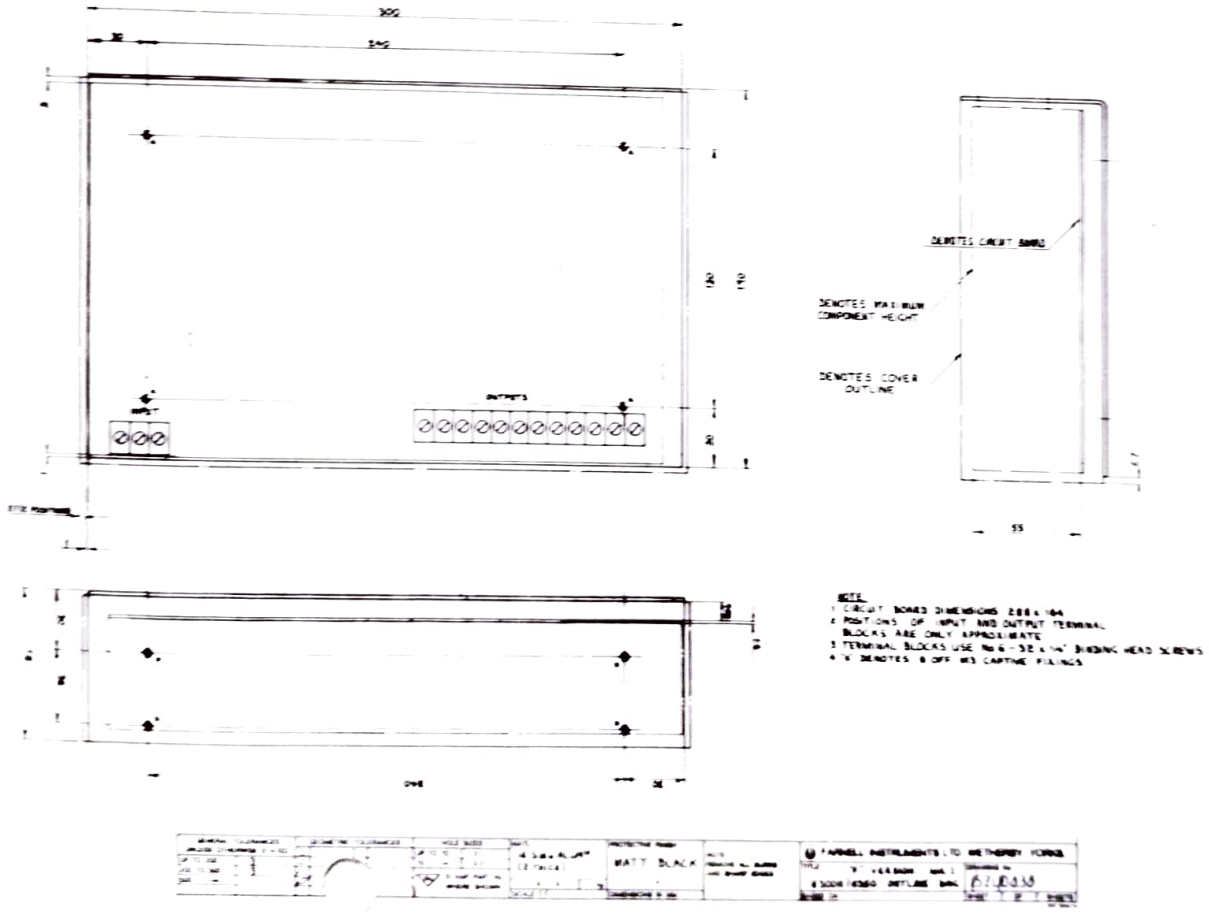
If an output overvoltage occurs the crowbar SCR is triggered, clamping output 2 and reducing the other output voltages by action of the power limit. The SCR remains in the triggered condition until the mains input supply is interrupted.

On both units a cross-regulator circuit is connected to output 1 current sense transformer to reduce the voltage variation of outputs 2 to 5 when output 1 load changes.

Outputs 2 to 5 of the N300R are individually stabilised and current limited by additional linear regulators. A low line inhibit circuit prevents the unit from supplying any output when the mains input is low and provides a suitable delay for the soft-start circuit.

Provision is made for remote sensing of the main output voltage at the load to compensate for load drops.

## MECHANICAL DETAILS


DENOTES CIRCUIT BOARD
DENOTES MAXIMUM COMPONENT HEIGHT
DENOTES COVER OUTLINE
55
NOTES.
1 CIRCUIT BOARD DIMENSIONS 288 x 164
2 POSITIONS OF INPUT AND OUTPUT TERMINAL BLOCKS ARE ONLY APPROXIMATE
3 TERMINAL BLOCKS USE No 6 - 32 x ¼" BINDING HEAD SCREWS
4 'X' DENOTES 6 OFF M3 CAPTIVE FIXINGS
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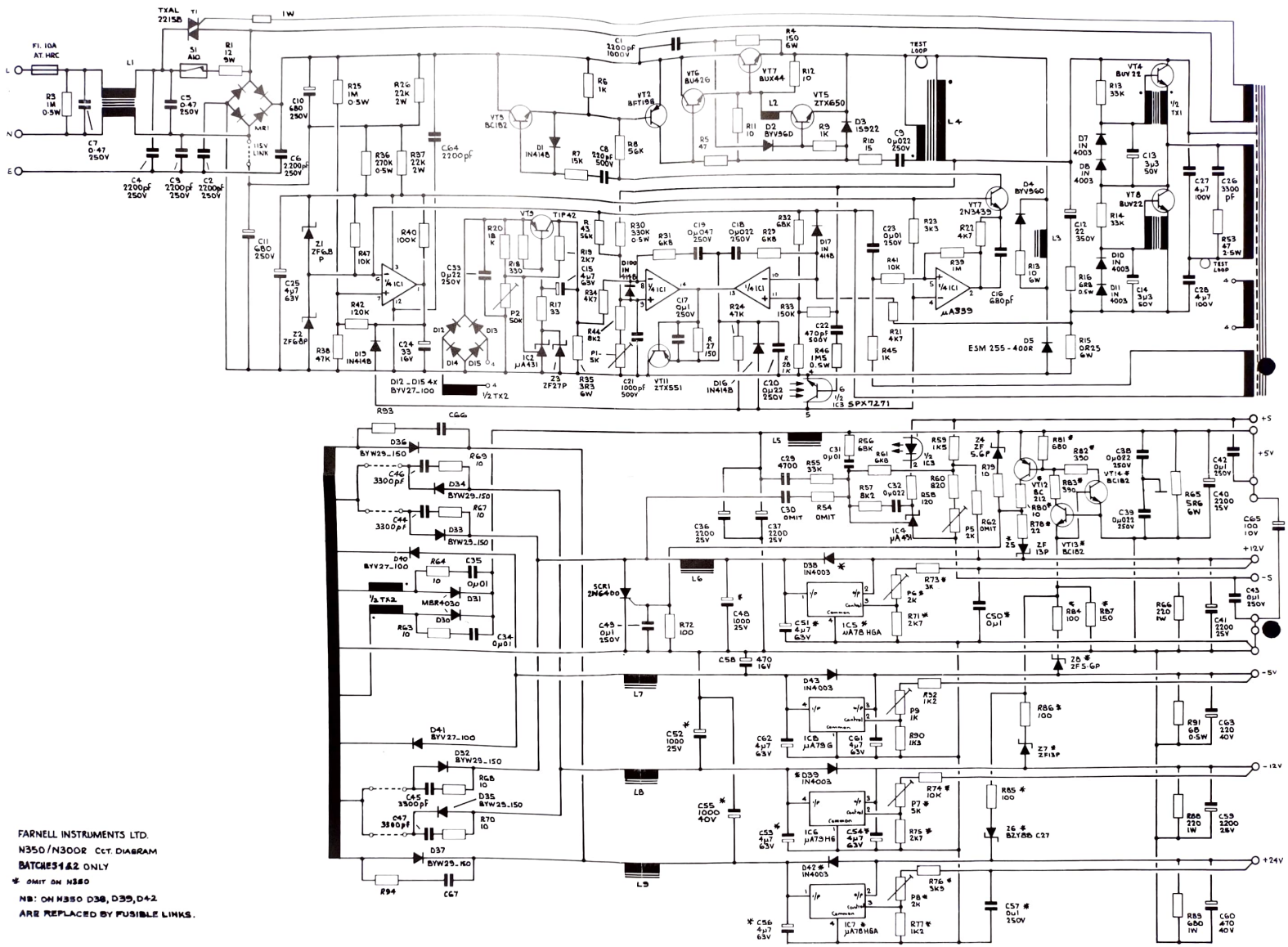
FARNELL INSTRUMENTS LTD WETHERBY YORKS

FARNELL INSTRUMENTS LTD. WETHERBY LS22 4DH. TEL 0937 61961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